Feb. 20, 1962 F. O. SEGER 3,021,724

ADJUSTABLE CAM DEVICE

Filed April 28, 1960 2 Sheets-Sheet 1

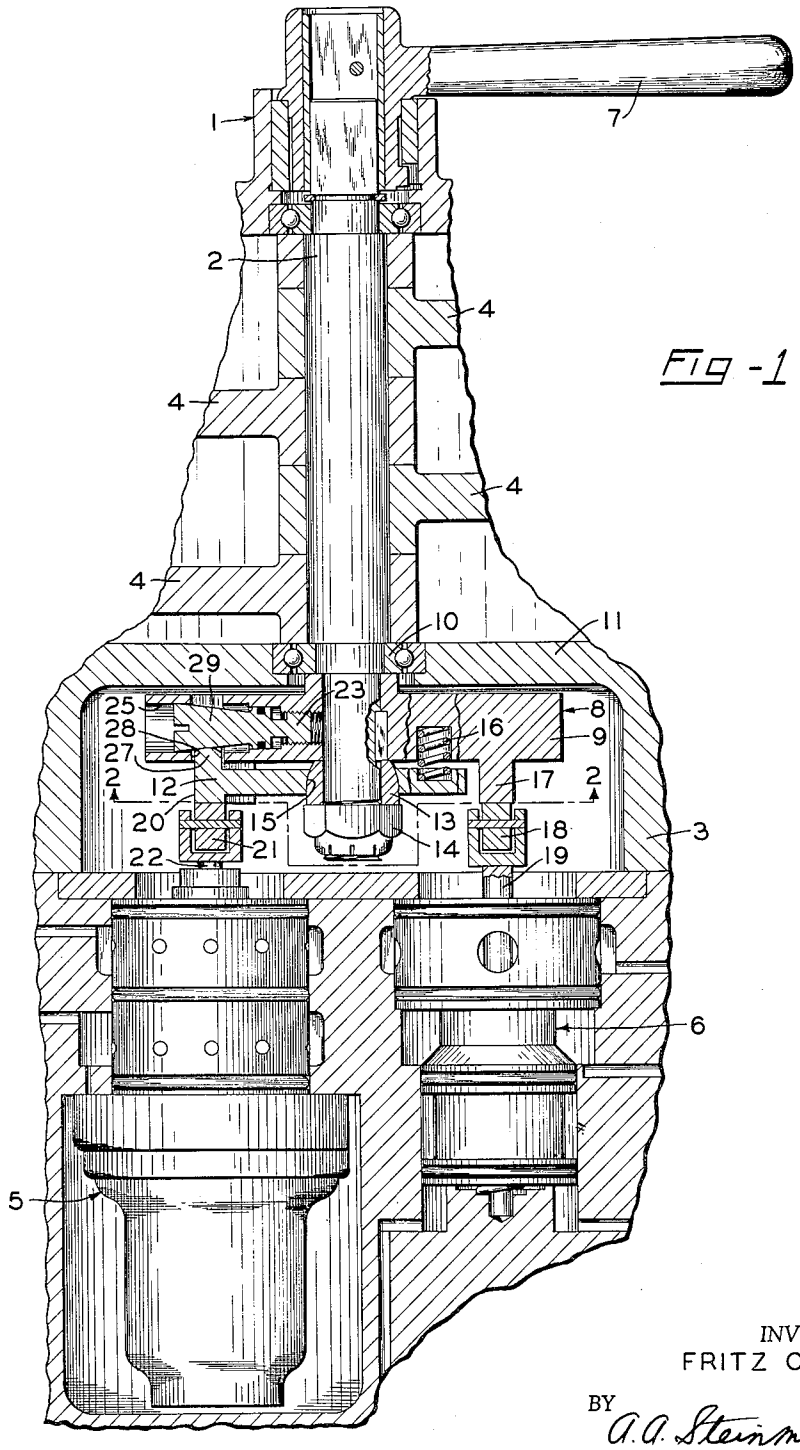


Fig -1

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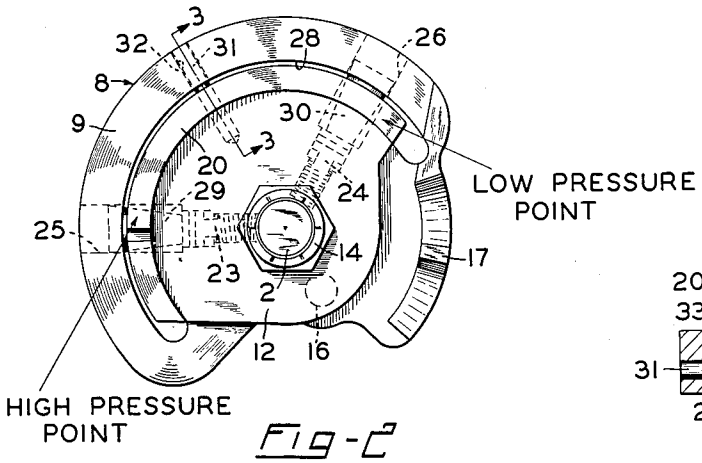


Fig - 2

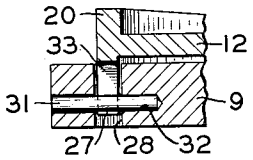


Fig - 3

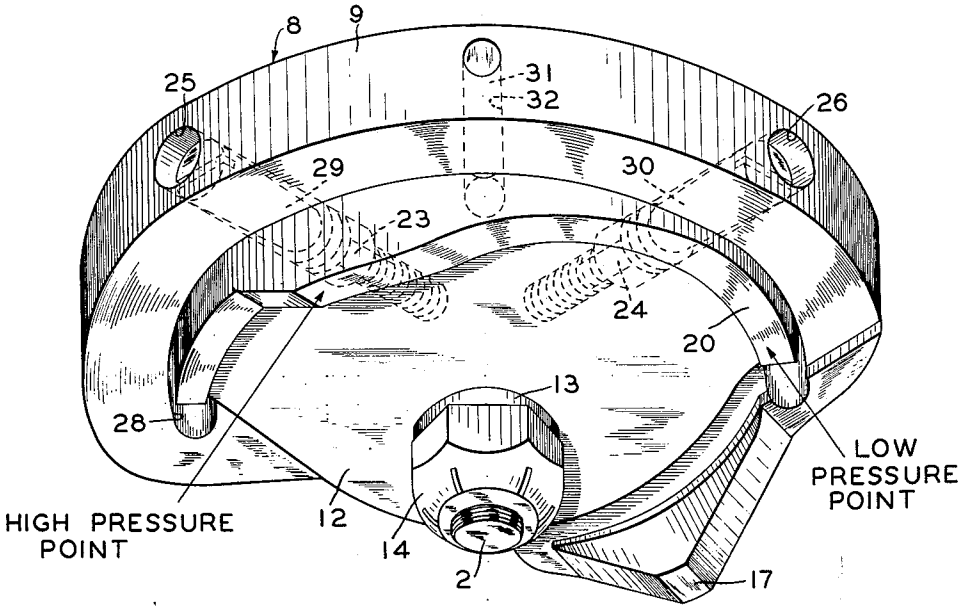


Fig - 4

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ADJUSTABLE CAM DEVICE

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This invention relates to adjustable cam arrangements and more particularly, to a cylindrical or plate type cam carried on and operable by a concentric camshaft and having novel means for adjusting the plane of operation of the cam plate relative to the camshaft axis, whereby the amount of axial movement imparted to the cam follower by the cam may be varied or adjusted.

The novel adjustable cam arrangement constituting the present invention imparts a greater versatility of use to shaft-operated cams, particularly the cylindrical type, as will be presently considered. Shaft-operated cams are used, for example, in certain types of engineers' brake control valve devices for railway vehicles and trains, such as the commonly known Westinghouse ME–42 Brake Valve, in which type of device the camshaft may have arranged thereon a plurality of axially spaced radial cams (similarly to the camshaft of an automobile), whereby, upon rotation of the camshaft, each cam operates a respective valve device arranged in the brake valve device at a right-angle relationship to the camshaft. In order to illustrate a practical application of the invention, the novel adjustable cam arrangement will be described as employed in the Westinghouse ME–42 Brake Valve, it being understood, however, that the use of the invention is not intended to be limited to said illustrative application. From the following description of the invention, it should be apparent that the novel adjustable cam arrangement claimed herein may be employed with any device operable by a cylindrical type cam and adjustable with respect to said cam operation for varying the results thereof. Since it is not deemed essential to an understanding of this invention, a detailed description of the ME–42 Brake Valve device has been omitted, and any further reference thereto hereinafter will be of a general nature.

As above noted, the several valve devices operated by the respective cams on the camshaft in the ME–42 brake valve device are customarily arranged at a right-angle relationship to said camshaft, one of said valve devices being a self-lapping valve device, which is operable by a respective cam on said camshaft when the latter is rotated by an operator's control handle fixed to one end of said camshaft exteriorly of the casing.

Briefly, the function of the self-lapping valve device is to control the supply of fluid under pressure to the straight air pipe of the brake system in a manner that the pressure of said fluid supplied to the straight air pipe is proportional to the amount of movement of the operator's control handle through a service zone, that is, the operating range of the control handle between the running position and the full service position, or between a certain low pressure value (usually atmospheric) at which the brakes are released and a certain high pressure value at which maximum braking is effected, the degree of braking between said low and high pressure values being proportionate to the amount of movement of the control handle. Since requirements for braking pressures may vary among various types of braking systems, the self-lapping valve device is usually disposed on the brake valve device in such position and manner as to provide accessibility thereto in order that the low and high operating pressure values, and therefore the operating pressure range of the service zone, may be adjusted

to the particular requirements of the braking equipment with which the brake valve device is employed.

Since, as above noted, the self-lapping valve device on the ME–42 brake valve device is customarily disposed at right angles to the axis of the brake valve device and the camshaft, and because said self-lapping valve device is more massive than the other valve devices operated by the camshaft, said self-lapping valve device protrudes beyond the general cylindrical contour of the brake valve device to such an extent that a rearrangement of said self-lapping valve device in the brake valve device is desirable in order to streamline the overall contour of the brake valve device, whereby less installation space therefor is required in the engineer's cab, while maintaining accessibility to said self-lapping valve device for adjusting the low and high operating pressure values.

It is the object of the invention, therefore, to provide a novel adjustable cam arrangement on a camshaft having means for adjusting the axial position of the surface of a cylindrical type cam relative to the camshaft, whereby the magnitude of motion imparted by the cam to a cam follower may be adjusted to the particular requirement of the device to be operated by the cam such as the example cited above, that is, the self-lapping valve device of an operator's brake valve device. By using the invention claimed herein, it is possible, as will be explained hereinafter, to rearrange the position of the self-lapping valve device in the brake valve device to provide a more compact unit having a contour requiring less installation space.

Essentially, the invention comprises a cylindrical type cam formed on a primary cam plate carried concentrically on a camshaft by a ball and socket arrangement and having means whereby the angular position of said cam plate relative to the axis of said camshaft may be adjusted. The primary cam plate is in contact, adjacent its periphery at three equi-angularly spaced bearing points, with an auxilary cam plate coaxially and rigidly keyed to the camshaft and axially spaced from said primary cam plate, both said acm plates being coupled to each other for rotation together. The respective axial distances between the primary cam plate and the secondary cam plate at two of said bearing points are independently adjustable while yieldable means are provided between the two cam plates at the third bearing point for biasing said cam plates apart and yet being yieldable for permitting swivel action of the primary cam plate, through the ball and socket arrangement, upon adjustment for increasing the axial distance between the two cam plates at one or both of the other two bearing points. Two adjusting screws are disposed in the auxiliary cam plate with their axes coinciding with two respective radii of said auxiliary cam plate lying in the radial planes passing through the respective adjustable bearing points, each of said adjusting screws having a tapered portion in peripheral contact with respective preselected bearing points on the primary cam plate, whereby, by screwing one or the other, or both, of the adjusting screws into or out of the auxiliary cam plate, the primary cam plate is caused to be pivoted at the ball and socket connection for increasing or decreasing the axial distance or distances between the two cam plates at one or both of said two preselected bearing points and thereby adjusting the angularity between said primary cam plate and the camshaft, the yieldable means at the third bearing point always providing a biasing action between the two plates for keeping them in solid contact at the two adjustable bearing points. By adjusting the angularity of the primary cam plate relative to the camshaft axis, as above described, the plane of rotation of said primary cam plate relative to said cam-

shaft axis is accordingly adjusted to provide the desired movement of the follower contacting the cam surface.

In the accompanying drawings, FIG. 1 represents an elevational view, mostly in section, of a portion of an operator's brake valve device with the invention applied thereto; FIG. 2 is a cross-sectional view taken along line 2—2 of FIG. 1 as viewed in the direction indicated by the arrows; FIG. 3 is a cross-sectional fragmental view taken along line 3—3 of FIG. 2 as viewed in the direction indicated by the arrows; and FIG. 4 is a perspective view, on a larger scale, of the cam assemblage shown in FIG. 2 and embodying the invention.

Description and operation

For purposes of illustrating a practical application of the invention, a cut-away portion of an ME–42 brake valve device, as modified by application of the invention thereto and as briefly above described, is shown and designated by the reference numeral 1 in FIG. 1. A camshaft 2 extends coaxially into a casing 3 of the brake valve device 1, said camshaft having fixed thereto a plurality of axially spaced radial cams 4 (partially shown) for operating respective valve devices (not shown) comprising components of said brake valve device. The lower portion of the casing 3, as viewed in the drawing, serves to house a self-lapping valve device 5 and an emergency valve device 6, both of which are generally shown in outline, it not being deemed essential to show said valve devices in detail to understand the invention. The valve devices 5 and 6 are disposed in the brake valve device 1 with their axes parallel to and at equi-radial distances from the axis of camshaft 2 and lying on opposite sides thereof in a plane containing said camshaft axis.

An operator's control handle 7 is removably carried at the exterior end of the camshaft 2 for operating said camshaft rotatably about its axis, whereby the radial cams 4 operate the several valve devices (not shown) as intended and in accordance with the angular position occupied by said control handle relative to the brake valve device 1. The control handle 7, in well-known maner, is operable from a release position at one extremity of a service zone, in which release position the brakes on the vehicles are released, through said service zone to a full service position at the other extremity thereof, in which full service position a maximum brake application is effected, the degree of brake application for any position of said handle between the release and full service positions being proportional to the amount of movement of said handle through said service zone. Beyond the full service position of the control handle 7, said handle is operable to an emergency position in which maximum application of the brakes on the vehicle is effected in the shortest time capable by the brake equipment, and thence to a handle-off position in which the brakes remain applied and the handle may be removed.

A cam assemblage 8 is carried interiorly of casing 3 on the end of camshaft 2 opposite the end at which the handle 7 is fixed so as to be in position for operating the valve devices 5 and 6.

According to the invention, the cam assemblage 8 comprises an auxiliary cam plate 9 coaxially keyed to the camshaft 2 for rotation therewith and abutting against the inner race of a ball-type bearing 10 mounted in an internal separating wall 11 in casing 3 for rotatably supporting the end of said camshaft adjacent said cam assemblage. A primary cam plate 12 is supported concentrically on the camshaft 2 by a bushing 13 carried on said camshaft and having one end abutting against the auxiliary cam plate 9, while a nut 14, for holding the cam assemblage 8 on said camshaft, is screwed on the end of said camshaft up against the other end of said bushing. The external surface of the bushing 13 is spheroidal in form, with the smallest circumference adjacent the auxiliary cam plate 9, to accommodate a conforming surface of a bore 15 formed coaxially in the primary cam plate 12 to thereby permit ball and socket action between said primary cam plate and the camshaft 2, the bushing acting as a ball and the bore acting as a socket. A spring 16 having its opposite ends disposed in opposing recesses formed respectively in the auxiliary cam plate 9 and the primary cam plate 12, is compressed between said two cam plates at a predetermined angular position thereon for biasing the same toward an axially spaced relationship on the camshaft 2.

The auxiliary cam plate 9 is provided with a cylindrical cam portion 17 (see FIG. 4) so radially spaced from the axis of said cam plate as to operably engage a follower 18 at the end of a valve stem 19 of the emergency valve device 6. The primary cam plate 12 is also provided with a cylindrical cam portion 20 (see FIG. 4) so radially spaced from the axis of said cam plate as to operably engage a follower 21 at the end of a valve stem 22 of the self-lapping valve device 5.

The primary cam plate 12 is in contact, adjacent its periphery, with the auxiliary cam plate 9 at three approximately equi-angularly spaced bearing points one of which is the point at which spring 16, above described, is situated. In order to illustrate the structure of spring 16 and its disposition in the cam assemblage 8 in FIG. 1, both cam plates 9 and 12 are shown cut away and the position of said pin has been angularly rotated in the drawing about the axis of cam plate 9 sufficiently to make it appear in the plane of the drawing. The other two of the above-mentioned points of bearing are provided by two adjusting screws 23 and 24 which may be screwed into or out of threaded portions of respective bores 25 and 26 having their axes coinciding with respective radii of the auxiliary cam plate 9 lying in angular positions approximately 120° from each other and from spring 16. The primary cam plate 12 has formed thereon, on the side facing auxiliary cam plate 9, a substantially semi-circular lip 27 running approximately halfway around the outer periphery of said primary cam plate so that when the cam plates 9 and 12 are in assembled position said lip extends axially into a semi-circular slot 28 running approximately 180° around the auxiliary cam plate on a radius corresponding to that of said lip on said primary cam plate and cutting perpendicularly across both bores 25 and 26, said lip making contact adjacent one end thereof with a tapered portion 29 of adjusting screw 23 and adjacent the other end with a tapered portion 30 of adjusting screw 24. A screw driver may be inserted in bores 25 and 26 for adjusting the screws 23 and 24, respectively.

A coupling pin 31 (see FIG. 3) conveniently angularly located (in this case between adjusting screws 23 and 24) is pressed into a radially disposed bore 32 in the auxiliary cam plate 9 cutting across slot 28. The lip 27 of the primary cam plate 12 adjacent pin 31 is provided with an axially disposed notch or slot 33 (see FIG. 3) straddling said pin, whereby the two cam plates are coupled to each other for rotation together. The notch 33 in lip 27 is of sufficient depth to prevent contact at any time of pin 31 with the bottom of said recess, as shown in FIG. 3, since said pin has no function in the adjustment of the primary cam plate 12, to be presently described, but merely serves as a coupling means, as above noted.

From the above description, it should be apparent that movement of the control handle 7 to any of its above enumerated positions causes corresponding rotative movement of the camshaft 2 and, therefore, of the radial cams 4 and the cam assemblage 8. Since it is not considered essential to an understanding of the invention, it suffices to merely note at this point that the character of the contours, lengths and other salient features of the radial cams 4 and the cam 17 of the cam assemblage 8 are designed to produce the desired operative effects on the respective devices controlled thereby.

As was above noted, however, it may be necessary to vary the fluid pressure operating range of the self-lapping valve device 5 to adjust it to the particular requirements of the brake equipment on the vehicle. The two adjusting screws 23 and 24 on the cam assemblage enables such adjustment when said cam assemblage embodying the invention is used with a type of brake valve device such as the brake valve device 1.

Cam 20 is so designed that its axial depth gradually increases from a minimum depth at one end to a maximum depth adjacent the other end, the respective positions of said minimum and maximum depths on the cam being designated in the drawings (FIGS. 2 and 4) as the "Low Pressure Point" and "High Pressure Point", respectively, because, when said cam is in contact with follower 21 at said low pressure point or at said high pressure point, the self-lapping valve device 5 is in operative condition for effecting supply of operating pressure to the straight air pipe at either minimum or maximum value, respectively. As the cam assemblage 8, and therefore cam 20, is rotated clockwise, as viewed in FIGS. 2 and 4, the cam surface of said cam moves over follower 21 through the service zone, that is, from the low pressure point to the high pressure point, which corresponds to the release position and full service position, respectively, of the control handle 7, thereby causing corresponding downward axial movement of valve stem 22 for effecting supply of fluid to the straight air pipe at a pressure directly proportional to the amount of movement of said control handle.

According to the invention and as viewed in FIGS. 2 and 4, it will be noted that the respective angular locations of the high and low pressure points on cam 20 substantially coincide with the angular locations of adjusting screws 23 and 24, respectively, in the cam assemblage 8. This arrangement permits individual adjustment of the high and low pressure points of the cam surface and, therefore, adjustment of the amount of resultant axial movement of the valve stem 22, as effected by movement of cam 20 over the follower 21. If, for example, screw 23 is screwed inwardly into bore 25, the peripheral point of contact of tapered portion 29 of said screw with lip 27 of the primary cam plate 12 changes to a point on said tapered portion located on a larger circumference thereof; thus, the screw acts as a wedge driven between the two cam plates 9 and 12. Because of the yieldable support provided by spring 16 between auxiliary cam plate 9 and primary cam plate 12, said spring yields upon adjustment of screw 23 to permit said primary cam plate to pivot about the spheroidal surface of bushing 13, thus producing an adjustment of angularity between the primary cam plate and the axis of camshaft 2, or adjustment of axial distance between the planes of rotation of the primary cam plate and the auxiliary cam plate, the maximum effect of said adjustment, insofar as the cam 20 is affected, occurring at the peripheries of said cam plates adjacent the high pressure point of said cam and gradually diminishing over the entire length of the cam to a minimum effect at the low pressure point, where the effect is so negligible as to be considered nil, if only screw 23 is adjusted. Correspondingly, the amount of axial movement of the valve stem 22 is also affected to produce a corresponding effect on the pressure of fluid supplied to the straight air pipe, the maximum effect occurring in the full service position of the control handle 7. Thus, an inward adjustment of the adjusting screw 23 causes adjustment of the high pressure point on the primary cam plate 12 away from the auxiliary cam plate 9 and, therefore, a correspondingly greater amount of movement of valve stem 22 and a corresponding increase in pressure of fluid supplied to the straight air pipe.

Since, as above noted, spring 16 axially biases the primary cam plate 12 apart from the auxiliary cam plate 9 at the point of location of said spring, it should be apparent that any adjustment of screw 23 by screwing said screw outwardly from bore 25 produces an opposite effect to that above described regarding the adjustment of the high pressure point on cam 20, that is, the axial distance between the two cam plates at said high pressure point is reduced and the amount of axial movement of valve stem 22 and, therefore, the pressure of fluid supplied to the straight air pipe is reduced accordingly.

From the description, immediately above set forth, of procedure and effects of adjustment of adjusting screw 23, it should be readily apparent that the adjusting screw 24 operates similarly to screw 23, except that the effect of adjustment of screw 24 is to vary the depth of the low pressure point of cam 20 with consequent corresponding variation of the pressure of fluid delivered by the valve device 5 when the control handle 7 is in its release position.

Having now described the invention, what I claim as new and desire to secure by Letters Patent, is:

1. An adjustable cam arrangement comprising, in combination, a rotatable shaft, a primary cam plate, mounting means for mounting said primary cam plate on said shaft in predetermined position substantially at right angles thereto and permitting limited angular movement of said primary cam plate out of said predetermined position to another position not at right angles to said shaft, an auxiliary cam plate fixed on said shaft in axially spaced relation to said primary cam plate, means coupling said primary cam plate and said auxiliary cam plate for rotation together, said primary cam plate having thereon a circular cam surface providing axial cam action parallel to the axis of said shaft, and a plurality of cooperating bearing means carried partly on said primary cam plate and partly on said auxiliary cam plate for providing three angularly spaced bearing points therebetween, at least one of said bearing means being adjustable to vary the axial spacing between said primary cam plate and said auxiliary cam plate at the corresponding bearing point for effecting angular adjusting movement of the primary cam plate with respect to its predetermined position.

2. An adjustable cam arrangement as defined in claim 1, further characterized by resilient means disposed between said primary cam plate and said auxiliary cam plate at one of said bearing points for providing a biasing effect for maintaining said primary cam plate and said auxiliary cam plate in said axially spaced relationship and for maintaining contact therebetween at said bearing points.

3. An adjustable cam arrangement as claimed in claim 1 wherein said mounting means comprises a concentric bushing removably secured on said shaft in abutting relation with the facing hub of said auxiliary cam plate, the external surface of said bushing being spheroidal in form, with its smallest circumference adjacent the hub of said auxiliary cam plate, for accommodating a conforming surface of a coaxial bore formed in said primary cam plate to thereby support said primary cam plate on said shaft and provide ball and socket action therebetween upon angular adjustment of said primary cam plate relative to the axis of said shaft.

4. An adjustable cam arrangement comprising, in combination, a rotatable shaft, a primary cam plate, mounting means for mounting said primary cam plate co-axially on said shaft in a predetermined position substantially at right angles thereto and permitting limited angular movement of said primary cam plate out of said predetermined position to another position not at right angles to said shaft, an auxiliary cam plate coaxially fixed on said shaft in axially spaced relation to said primary cam plate, means coupling said primary cam plate and said auxiliary cam plate for rotation together, said primary cam plate having thereon a circular cam surface providing axial cam action parallel to the axis of said shaft, yieldable means interposed between said primary cam plate and said auxiliary cam plate, adjacent their peripheries at a preselected angular location relative thereto, for providing a biasing effect for maintaining said primary cam plate and said auxiliary cam plate in said axially spaced rela-

tionship at one of three equi-angularly spaced points of bearing contact between the two plates adjacent the peripheries thereof, and respective adjusting means disposed in said auxiliary cam plate and providing the other two of said bearing points and thereby cooperating with said yieldable means for maintaining said primary cam plate and said auxiliary cam plate in said axially spaced relationship, said adjusting means being independently operable for varying the axial distance between the two cam plates, thereby to vary said axial cam action of said cam surface.

5. An adjustable cam arrangement as defined in claim 4 wherein each of said adjusting means comprises an adjusting screw which may be screwed into or out of a bore having its axis coinciding with a preselected radius in said auxiliary cam plate adjacent the respective bearing point, said adjusting screw having formed thereon an axially extending tapered portion for making said contact with said primary cam plate at the respective bearing point, whereby, upon screwing of said adjusting screw into or out of said bore, said axial distance between said primary cam plate and said auxiliary cam plate is lengthened or shortened, respectively.

6. An adjustable cam arrangement as defined in claim 4 wherein said mounting means comprises a concentric bushing removably secured on said shaft in abutting relation with the facing hub of said auxiliary cam plate, the external surface of said bushing being spheroidal in form, with its smallest circumference adjacent said hub of said auxiliary cam plate, for accommodating a conforming surface of a coaxial bore formed in said primary cam plate to thereby support said primary cam plate on said shaft and provide ball and socket action therebetween upon angular adjustment of said primary cam plate relative to the axis of said shaft.

7. An adjustable cam arrangement comprising in combination, a rotatable shaft, an auxiliary cam plate coaxially secured to said shaft for rotation therewith and having formed therein a circular slot cutting axially through and extending approximately 180° around said auxiliary cam plate adjacent its periphery, a primary cam plate supported coaxially on said shaft in a predetermined position substantially at right angles thereto and in axially spaced relation to said auxiliary cam plate, means coupling said primary cam plate and said auxiliary cam plate for rotation together, a concentric bushing removably secured on said shaft with one end abutting

against the facing hub of said auxiliary cam plate, the external surface of said bushing being spheroidal in form, with its smallest circumference adjacent said hub, for accommodating a conforming surface of a coaxial bore in said primary cam plate to thereby support said primary cam plate on said shaft and provide ball and socket action therebetween for limited angular adjustment of said primary cam plate relative to the axis of said shaft, said primary cam plate having formed on the side facing said auxiliary cam plate a circular lip running approximately 180° around the periphery of said primary cam plate and extending axially into said slot on the auxiliary cam plate, the opposite face of said primary cam plate having formed thereon an axially extending cylindrical cam engageable with a cam follower of a device to be controlled by said cam, yieldable means interposed between said primary cam plate and said auxiliary cam plate, adjacent their peripheries at a preselected angular location relative thereto, for providing a biasing effect for maintaining said primary cam plate and said auxiliary cam plate in said axially spaced relationship at one of three equi-angularly spaced points of bearing contact between the two plates adjacent the peripheries thereof, and a pair of adjusting screws disposed in said auxiliary cam plate and spaced thereon at approximately 120° relationship to each other and to said yieldable means, said adjusting screws each being independently adapted to be screwed into or out of a respective bore cutting across said slot in said auxiliary cam plate with its axis coinciding with a preselected radius of said auxiliary cam plate so that when in place each of said screws extends across said slot to permit said lip on said primary cam plate to make said contact at said other two bearing points by resting against respective axially extending tapered portions formed on said screws, whereby, upon screwing of said adjusting screws into or out of their respective bores, said tapered portions cause said primary cam plate to be pivoted correspondingly about said bushing and thereby cause corresponding adjustment of the axial distance between the two cam plates at the several points of bearing.

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